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ABSTRACT

This review of the literature examines barriers to building community and fostering involvement among female undergraduate and graduate students in engineering. It also explores a comprehensive set of strategic initiatives that can be taken by women in engineering advocates to build a sense of community and mutual support among students. Barriers confronting women in this regard included their assumption of multiple roles, as learners, mothers, daughters, partners, and professionals; the experience of role conflict between these roles and conflicting demands; the lack of available resources, such as time and finances; the "chilly climate" of the engineering discipline; and the devaluation of women's relational orientation prevalent in the engineering classroom. The strategic goals of women in engineering to dismantle these barriers are discussed in the context of the SPAR (Services, Programs, Advocacy, and Research) Model for program implementation. A number of theoretical models of student development, involvement, and retention are also briefly discussed as appropriate for designing and implementing programs and initiatives that are responsive to women's needs. (Contains 15 references.) (CK)

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Involving Students Through Building Community: Challenges for Women in Engineering Programs

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Summary

Establishing and maintaining a sense of community among students is a major challenge facing women in engineering programs and initiatives today. In reviewing the retention literature, particularly as it relates to women and other nontraditional students, building community as a means of retention was a recurring theme. Within the context of student development and retention theory, including student involvement (Astin, 1984), marginality versus mattering (Schlossberg, 1989), and noncognitive variables (Sedlacek, 1991), this research report examines barriers to building community and fostering involvement among female undergraduate and graduate students in engineering. Based on the SPAR Model (Jacoby & Girrell, 1981) of program implementation, a comprehensive set of strategic initiatives that can be taken by women in engineering advocates to build a sense of community and mutual support among students will also be explored.

Rationale

The critical mass of female students in engineering decreases as women proceed through their undergraduate and graduate education. In addition, the "chilly climate" embedded in the environment and culture of engineering often leaves women students at-risk for feeling isolated and disconnected from their peers and the institution. Within this context, women students who feel that they have a sense of identification with others -- a sense of community -- will be more likely to become involved in their educational experiences and persist at the institution. The framework of community is perhaps one of the best ways to involve women engineering students and ultimately, increase the likelihood that they will be retained. In implementing programs and initiatives aimed toward increasing student retention, it is important to explore the "why" behind retention as well as the "how" through the critical lens of student development and retention theories. Such theories provide legitimacy and justification to retention initiatives as well as a conceptual framework through which women in engineering advocates can intentionally implement programs that respond to the needs of diverse student populations.

Introducing Theoretical Models

According to Astin's (1984) theory of student involvement, colleges and universities that involve their students in their educational experiences not only enhance student learning outcomes, but also increase student retention. Astin (1984) explained that student involvement refers to the "amount of physical and psychological energy that the student devotes to the academic experience" (p. 297). According to Astin (1984), it is both the quantity and quality of students' involvement that ultimately leads to their retention. Based on a longitudinal study involving college students who left their institutions before attaining a degree, Astin (1984)

found evidence for the existence of certain factors in college environments that tend to influence student persistence. According to Astin (1984), factors associated with increased levels of student involvement included: residing on campus, holding an on-campus job, participating in intercollegiate sports, being involved in honors programs, engaging in research with faculty, and establishing a high level of identification and affiliation with the institution. It is also important to acknowledge that "student involvement" in typically conceptualized in terms of extracurricular and cocurricular activities, but Astin referred to involvement in a more comprehensive context -- a student's experiences both inside and outside the classroom. In this respect, it is interesting to note that "frequent interaction with faculty is more strongly related to satisfaction with college than any other type of involvement or, indeed, any other student or institutional characteristic" (Astin, 1984, p. 304).

In exploring the interrelated concepts of student involvement, community, and retention through her theory of "marginality versus mattering," Schlossberg (1989) explained:

> Involvement creates connections between students, faculty, and staff that allow individuals to believe in their own personal worth. This involvement also creates an awareness of our mutual relatedness and the fact that the condition of community is not only desirable but essential to human survival. Therefore, the concern over involving students, although expediently related to satisfaction and retention, is the very process that creates community (p. 6).

In essence, Schlossberg acknowledged that students will ask themselves, "Do I belong here?" A student, for example, who feels that she matters to the institution and to others has internalized the notion that others depend on her and are concerned with her fate. In contrast, a student who

thinks that she does not matter will feel marginalized. As a result, she may be at-risk for isolation from her peers and a sense of disconnection from the institution, both of which could serve as barriers for her educational persistence. Thus, a female engineering student's level of mattering will ultimately shape her experiences and level of motivation to further pursue engineering. Within this context, students who feel a sense of identification with others and the institution -- a sense of community -- are more likely to become involved and persist. Therefore, the framework of community is perhaps one of the most powerful mediums through which to involve women engineering students, enhance their educational experiences, and increase their likelihood of completing their engineering degree.

Sedlacek (1991) also acknowledged that involvement and community are important factors in the retention of nontraditional students. Sedlacek (1991) defined nontraditional students as including "women, cultural/racial minorities, and so on. Thus, nontraditional students are those other than white, upper-middle class males, the group for whom most of our higher education system has been designed" (p. 75). Especially within the context of engineering education, women can be considered as nontraditional students. According to Sedlacek (1991), nontraditional students are more effectively retained when considering the following eight noncognitive variables that significantly affect their lives: Positive Self-Concept or Confidence, Realistic Self-Appraisal, Understands and Deals with Racism, Prefers Long-Range to Short-Term or Immediate Needs, Availability of Strong Support Person, Successful Leadership Experience, Demonstrated Community Service, and Knowledge Acquired in a Field. Noncognitive variables are important because "traditional measures such as standardized tests and prior grades are of limited ability in working with nontraditional students. Nontraditional

students show their abilities in other ways" (Sedlacek, 1991, p. 75). In a longitudinal research study by Ancis and Sedlacek (1995) involving women students and noncognitive variables as predictors for academic achievement, Demonstrated Community Service before college emerged as the strongest predictor of grades in semesters 1, 3, 5, and 7 for women students. Given women's relational orientation, it appears that involvement within a community is instrumental to their lives and can have a significant impact on their educational experiences as well.

Although theories of student development, involvement, and retention are integral in giving voice to the experiences of college students and assisting educators in fostering their development, a major limitation of many theories is that they were developed and based on the experiences of traditional-aged students, many of whom were white, middle-class males at four-year residential institutions (Jacoby, 1991). This brings to question the appropriateness of applying such theories for work with diverse student populations on college and university campuses today, including women engineering students. In exploring the degree of applicability of these theories to women students through the contexts of involvement, retention, and community, how can women in engineering programs and initiatives ensure that female undergraduate and graduate students have the opportunity to become involved in their institutions and feel that they matter to others?

In attempting to answer this question, one conceptual model in the literature that can serve as a framework for structuring and implementing women in engineering programs that are sensitive to the diverse needs of students is the SPAR Model (Jacoby & Girrell, 1981). Within this conceptual framework, functions that enhance the educational and cocurricular experiences of students can be organized along the following four interrelated dimensions: (1) Services

(functions that are performed for students), (2) Programs (functions that are performed with students), (3) Advocacy (functions that are performed on behalf of students), and (4) Research (the vital ingredient that determines the types of services, programs, and advocacy best suited to meet the diverse needs of students). Including these four components in women in engineering programs and initiatives can increase student involvement, intentionally foster a sense of community among students, and increase the overall quality of women's experiences at the institution.

Examining Barriers to Involvement, Mattering, and Community

It is important to acknowledge that a number of real and perceived barriers exist for women in engineering, both in terms of their educational experiences and in the professional world. In addition, both individual and institutional factors serve as barriers to fostering involvement, mattering, and community among female undergraduate and graduate students in engineering. First, in examining individual barriers, women experience multiple roles -- as learners, mothers, daughters, partners, and professionals -- that may serve as challenges to their involvement in their educational experience. Related to this, a phenomenon commonly cited in the research literature is that of "role conflict," which Stoltz-Loike (1993) explained "results when individuals must function simultaneously within multiple roles and the demands for optimal performance in each role cannot be simultaneously achieved. Role conflict can lead to stress, anxiety, or decreased levels of performance at work or at home" (p. 116).

Directly related to role conflict is the issue of lacking available resources, including time and finances. For example, a female student who is attempting to balance multiple caretaking responsibilities along with holding a job and the rigorous demands of the engineering curriculum

will have less time to become involved -- such as living on campus, making friends in classes, participating in academic study groups, or taking part in engineering societies. In contrast, students who do not have these other roles and responsibilities have many more opportunities to become involved. In this respect, involvement in one's academic and cocurricular experience is a privilege that is not easily achievable for all women students.

On the institutional level, the "chilly climate" of the engineering discipline may serve as a hindrance to female students' involvement and feelings that they belong and matter. The emerging literature on engineering education suggests a link between the impersonal, individualistic, and competitive norms imbedded in the culture of engineering and the underrepresentation of women in engineering (Barber, 1995; Brush, 1991; Ginorio, 1995). Examining this phenomenon in the context of student development theory, it is clear that the engineering curriculum does not always foster a feeling of belonging for women students. Instead, students enter the discipline with the unspoken understanding that most introductory engineering courses are meant to "weed out" students (Ginorio, 1995; Tobias, 1990). Thus, students must earn the privilege of belonging to the engineering community by successfully completing these tasks. For female students, however, this is even more complex since many of the factors that help to sustain students are not available, such as a critical mass of like-minded peers and female role models. In many ways, introducing the concept of community-building among students directly challenges the current paradigm of engineering education.

Relationships and connection are central components in women's psychological development (Gilligan, 1982; Jordan, Kaplan, Miller, Stiver, & Surrey, 1991). Jordan and associates (1991) stated that "for women at all life stages, relational needs are primary and

healthy, dynamic relationships are the motivating force that propels psychological growth" (p. 37). They further explained that a woman's self-esteem and sense of self worth are directly related to the extent that mutuality is developed within her relationships. However, the devaluation of women's relational orientation is pervasive throughout society (Gilligan, 1982). This is particularly true within the culture of engineering, which is often characterized by a highly impersonal and competitive training process. Barber (1995) illuminated that boys are socialized to develop qualities (i.e., assertiveness, competitiveness, linear thinking) that are most often rewarded in the culture of science and engineering. In contrast, for girls becoming a scientist or engineer challenges the core of self, which is relational. This can communicate to female students that their way of relating to the world is not valued within the engineering community and therefore, they do not belong or must suppress a part of themselves in order to feel that they belong.

The devaluation of women's relational orientation is particularly prevalent in the engineering classroom, where often only a few learning styles are highly valued and rewarded. Research examining women's cognitive development has shown that while male students prefer to argue and debate in class, women students are often reluctant to share their views, express their opinions, or provide answers for fear of alienating others (Belenky, Clinchy, Goldberger, & Tarule, 1986). In an environment perceived as competitive and hostile, women may become even less inclined to speak out. In addition, the lack of examples that include women clearly communicates to female students that their presence in the classroom is insignificant. Furthermore, marginalization impacts women outside the classroom, where opportunities to establish mentoring relationships with faculty, receive research funding, and other educational

experiences are rewarded to students who fit the non-relational cultural norms and criteria for success.

Building Community Among Women Engineering Students

In linking barriers associated with involvement and mattering to building community among women engineering students, it is first important to provide operational definitions of community. Accordir to Hillery (1955) as cited in Johnson (1991), a community is "a group of individuals engaged in social interaction, possessing common interests and goals, who show concern for and are sensitive to the needs of other members, and are primarily interested in furthering the group goals over all others" (p. 3). In a similar vein, Schlossberg (1989) introduced the notion that "those working to build a sense of community through activities are challenged not only to understand why certain individuals get involved, thereby creating community among themselves, but also why others seem unable to establish connections or meaningful level of involvement." Many women engineering students feel isolated and may actively seek out opportunities to make connections with other women, and it is important that women in engineering advocates and educators are sensitive to their needs and facilitate such contacts. Other women engineering students may not be responsive to such initiatives and feel that they will be singled out or given preferential treatment because they are women, and they will be less likely to take advantage of such opportunities. Thus, Schlossberg (1989) challenges us to meet students where they are at and understand where they are coming from. In any case, the aforementioned barriers to involvement and mattering for women engineering students -- role conflict, limited resources, the chilly climate of engineering, and the devaluation of women's relational orientation -- can make community-building a particularly difficult challenge.

In exploring the interrelated concepts of involvement, mattering, and community, it is apparent that one of the strategic goals of women in engineering programs and initiatives should be to dismantle barriers that hinder women students. In reintroducing the SPAR (Services, Programs, Advocacy, and Research) Model (Jacoby & Girrell, 1981) for program implementation, women in engineering programs can organize their initiatives and refine their focus in dismantling such barriers as a primary tenet of their structure, functioning, and mission. The SPAR Model was originally developed as a conceptual framework for implementing comprehensive programs for commuter students -- a group of college students who are less likely to be retained than those who reside on campus. The model can also be applied in the work of women in engineering advocates as a means of developing comprehensive programs and initiatives for undergraduate and graduate women engineering students. As cited in the 1995 WEPAN Data Book, there already exist numerous initiatives on college and university campuses that actively seek to foster involvement and community among women engineering students. The following four facets of the SPAR Model provide a holistic approach to implementing community-enhancing initiatives for women engineering students: Services, Programs, Advocacy, and Research.

Services: Services are functions that are performed for students, and it is integral that they are both appropriate for and accessible to students (Jacoby, 1991). Within the context of women in engineering programs, services provided may include job and scholarship listings; workshops on career development and graduate school; personal, academic, and career counseling; and opportunities for student employment. In this respect, fostering collaboration with campus resources such as the counseling center, career center, and the financial aid office is

extremely important. At the same time, one of the most important yet often overlooked facets of providing services is disseminating information about them, as students are often unaware of the institutional resources available. Distributing newsletters, compiling e-mail aliases of women students in various engineering departments, informing faculty of services, and collaborating with engineering student societies can be effective measures to achieve this end. Women in engineering advocates can serve as a vital link between students and the institution at large and facilitate important contacts that may not happen otherwise. Thus, women students see that the institution is responsive to their needs and that they actually "matter" to others.

Programs: Programs are functions that are performed with students (Jacoby, 1991). Programs responding to the needs and interests of women engineering students may include: mentoring with professional engineers; teaching and research fellowship opportunities; collaboration with community colleges; tutoring programs; and engineering outreach programs with high school, middle school, and elementary school students. Through their participation, women become actively involved with other students, faculty, and staff, and have the opportunity to develop connections and significant relationships that are central to their psychosocial and cognitive development. These programs not only provide women engineering students with valuable personal and professional experiences, but they also enhance their sense of self-efficacy, help them gain valuable interpersonal skills in working with others, and foster their leadership potential.

Advocacy: Advocacy occurs on behalf of students to ensure that their needs and interests are being recognized and incorporated into the policies, practices, and culture of the institution (Jacoby, 1991). In terms of advocacy, women in engineering programs play a vital role on

campus in raising awareness surrounding women's issues, particularly with respect to male-dominated academic disciplines and professions. Women in engineering programs can sponsor curriculum transformation initiatives, facilitate workshops on sexual harassment, and conduct research about women in the sciences and the barriers they often face. In this capacity, they ultimately serve as advocates not only for women in engineering, but also for creating a gender-equitable climate for all students on campus.

Research: Finally, research serves as the vital link between the key components of services, programs, and advocacy (Jacoby, 1991). Through research, women in engineering advocates can assess the needs of women students, design programs and services accordingly, and evaluate their initiatives in terms of their quality and effectiveness. Research, evaluation, and assessment ultimately inform and justify the existence of programs and services as well as determine priorities, directions, and future initiatives. Research can take on both quantitative and qualitative forms, including surveys, focus groups, and informal discussions that bring together diverse groups of undergraduate and graduate women. The focus group model, in particular, extends beyond the goals of research and evaluation by fostering community among female engineering students and creating a forum through which they can share their experiences with each other.

Conclusion

In conclusion, a number of theoretical models of student development, involvement, and retention are available for women in engineering advocates to use in designing and implementing programs and initiatives that are responsive to women's needs. Much of the retention research indicates that building community is perhaps the best means through which to involve women

students in their educational experiences and enhance their feelings of belonging and mattering. Women in engineering advocates must challenge each other to explore theories of student development and retention to shape and justify our programs and initiatives and to ultimately create a community of learners that is inclusive of all engineering students.

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